Repeated Observations

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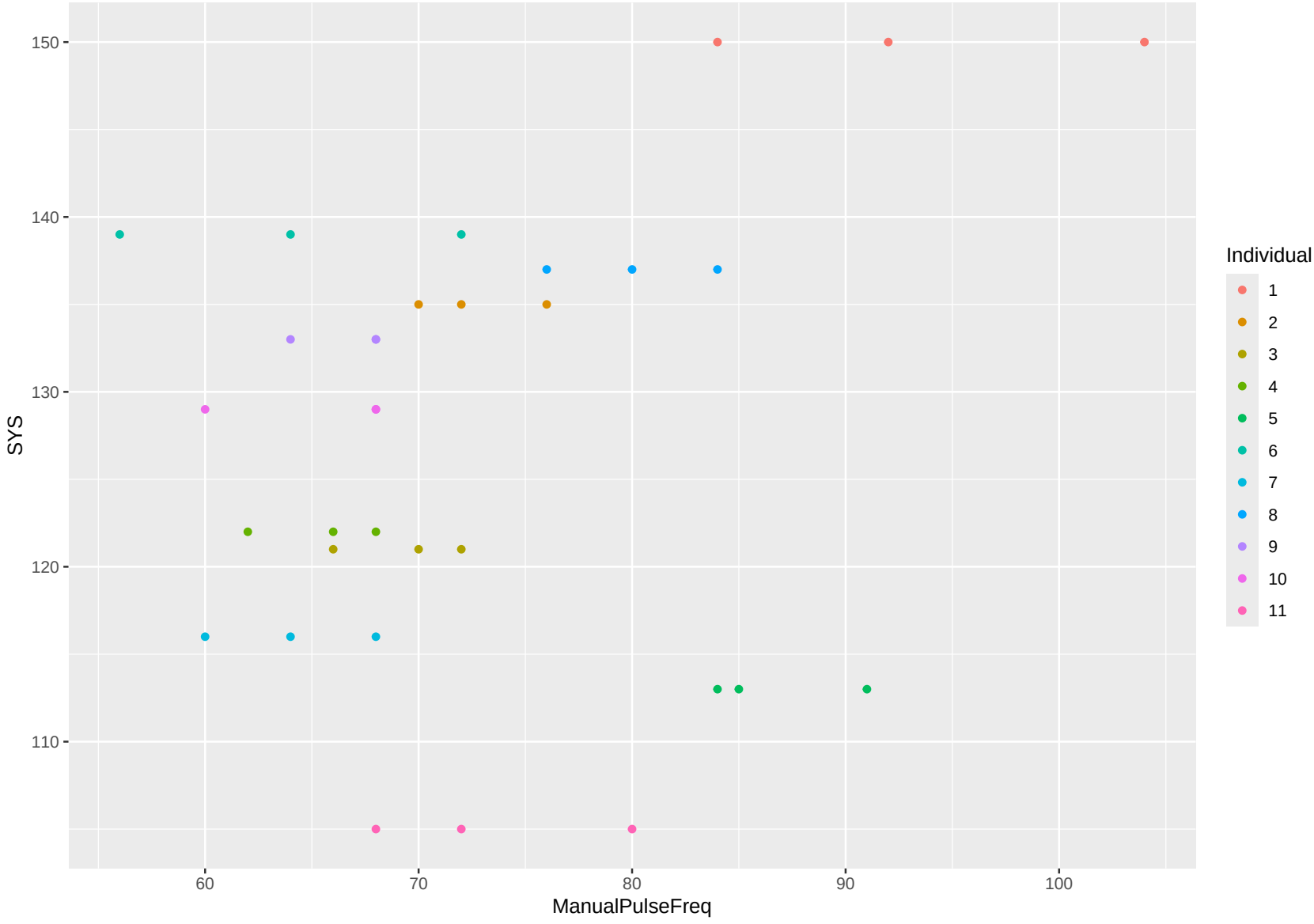
Three Types of Datastructures

1. Repeated observations in the predictors
2. Repeated observations in the response variables
3. Repeated observations in both the predictors and the responses

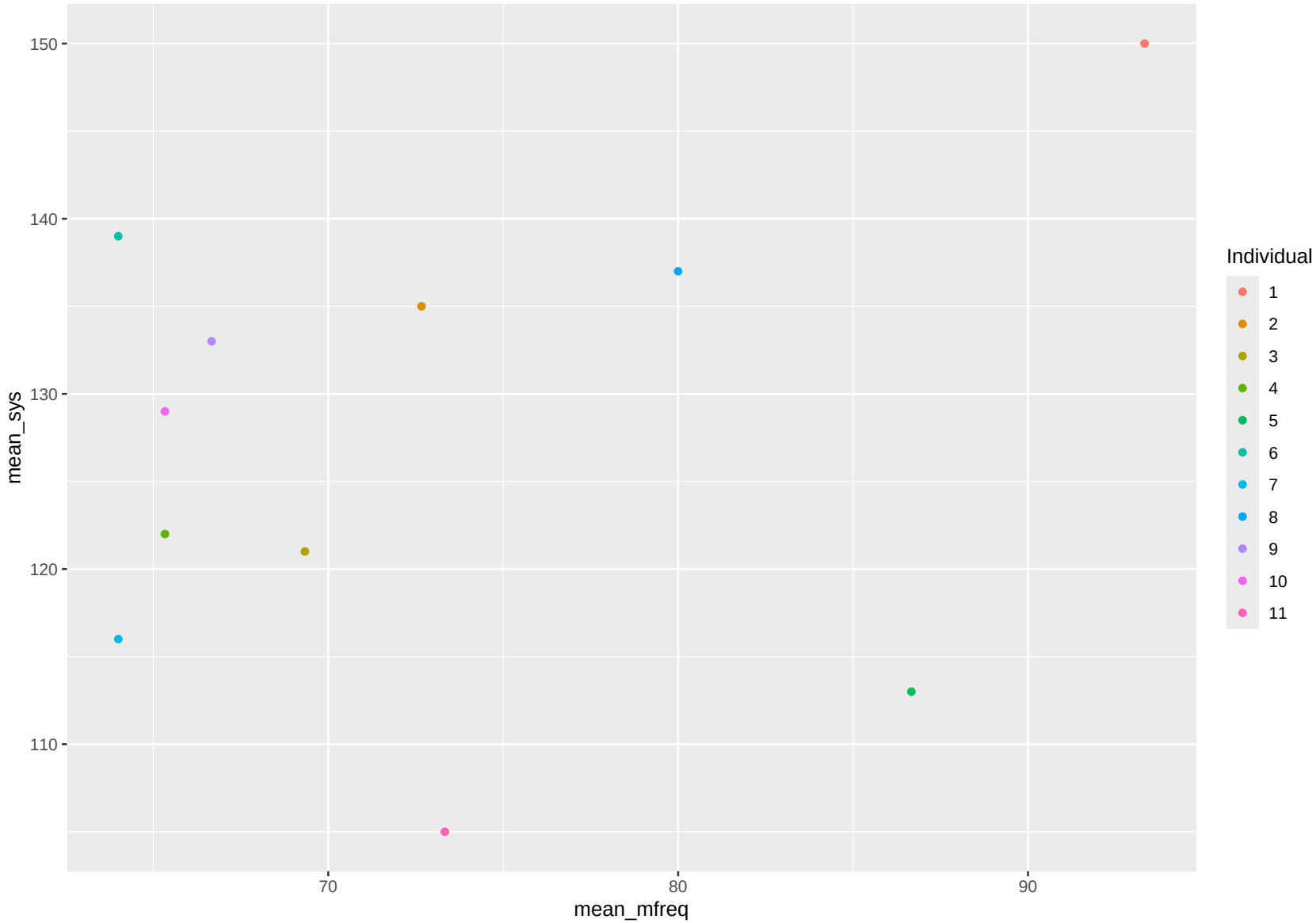
Repeated Observations in the Predictors

Dataset on blood pressure and heart frequency



Statistical Analysis

- Linear regression of response on `mean` (`median`) of predictors
- Example: `SYS` as response



Regression

```r
lm_msys_mfreq <- lm(mean_sys ~ mean_mfreq, data = tbl_bp_mf
summary(lm_msys_mfreq)
```

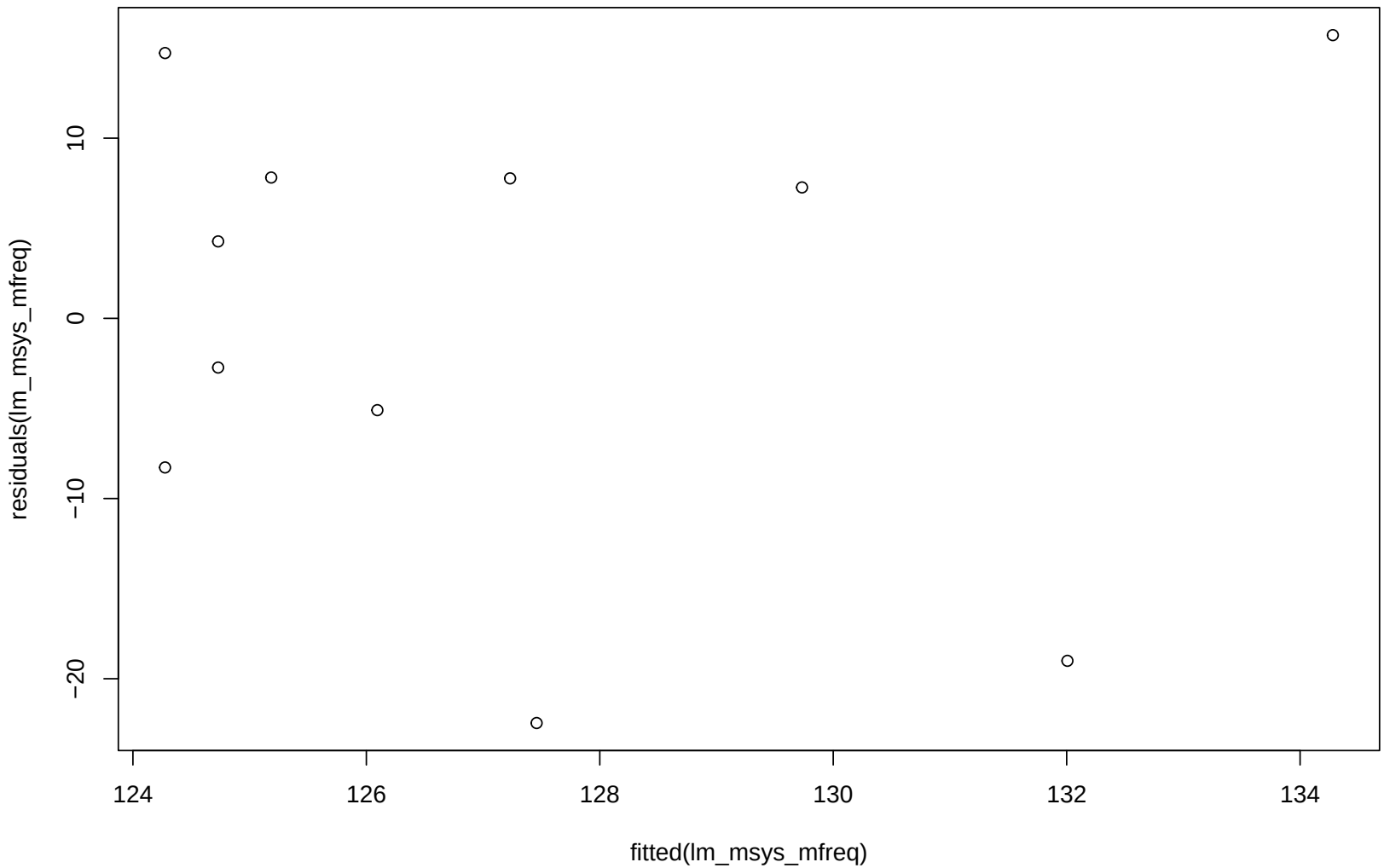
```
Call:
lm(formula = mean_sys ~ mean_mfreq, data = tbl_bp_mfreq_mea

Residuals:
    Min      1Q  Median      3Q     Max
-22.459  -6.685   4.270   7.792  15.720

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 102.4456    31.4616   3.256   0.0099 **
mean_mfreq    0.3411     0.4286   0.796   0.4467
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 '
```

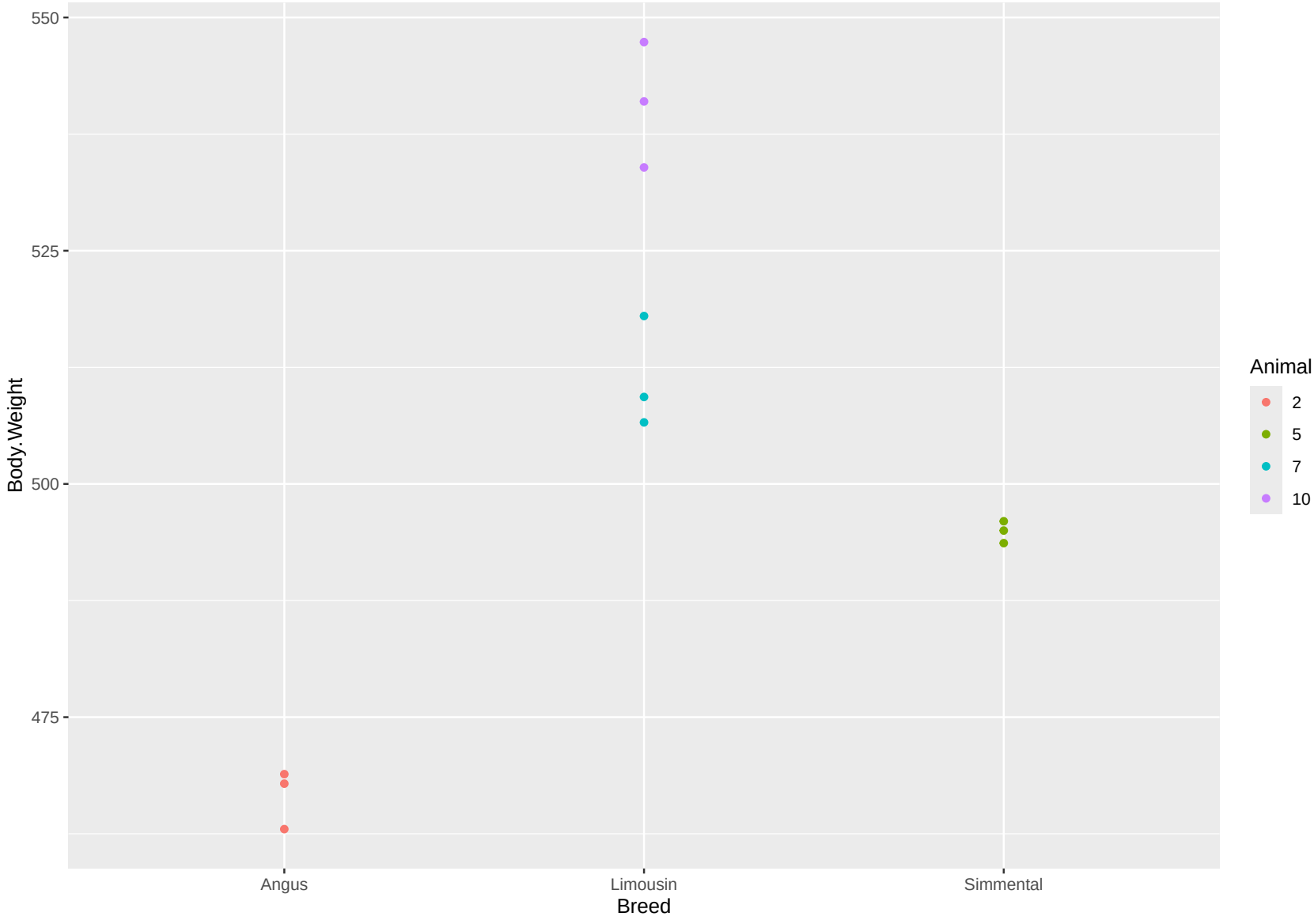
Residuals Plot

```
plot(fitted(lm_msys_mfreq), residuals(lm_msys_mfreq))
```



Repeated observations in the Response

Breed on Body Weight in beef cattle animals



Statistical Analysis

- Mixed effects model
- Use `lme4::lmer()` for analysis

```
library(lme4)
lmer_bw_br <- lmer(Body.Weight ~ Breed + (1 | Animal),
                   data = df_bw_br_rep)
```

Results

```
summary(lmer_bw_br)
```

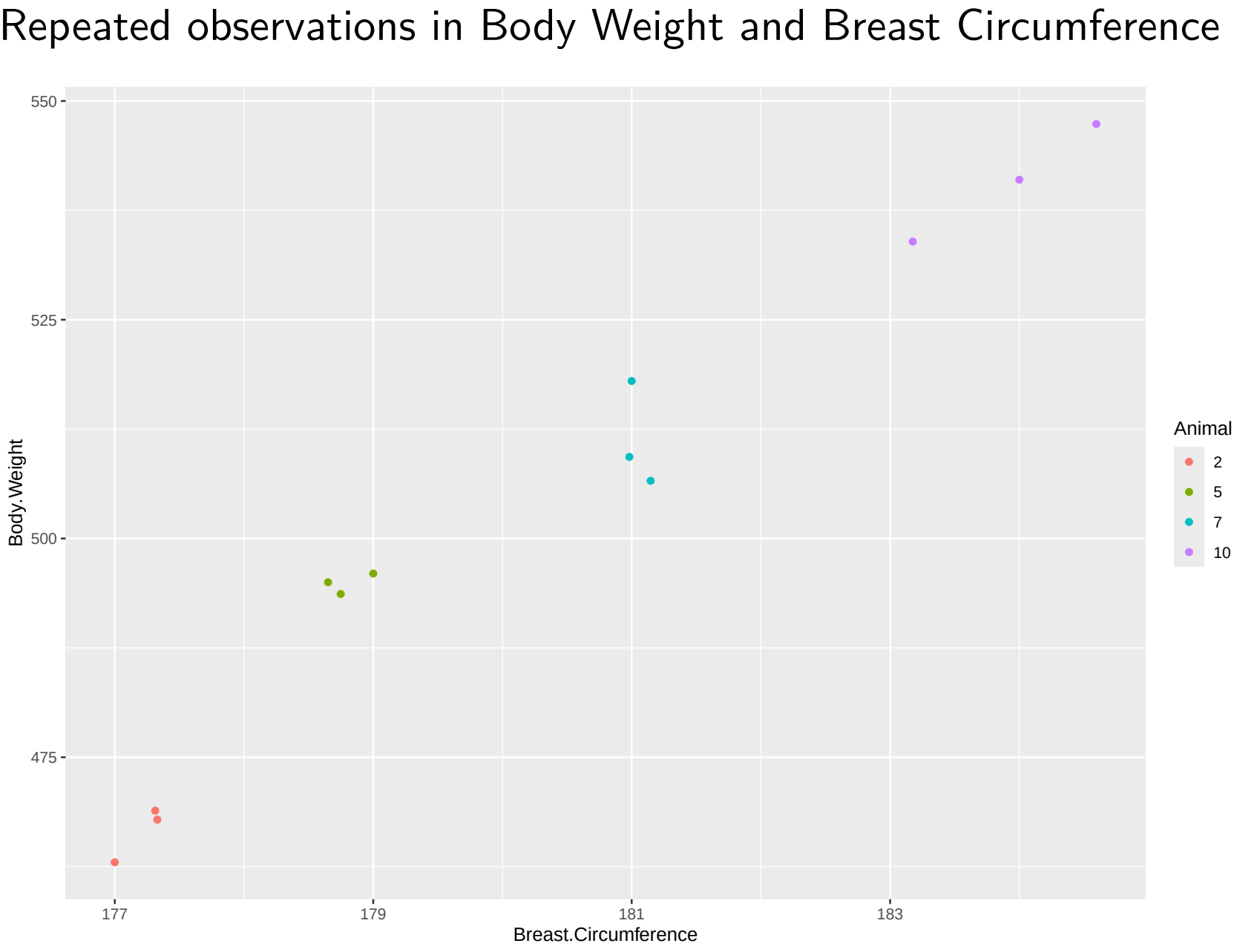
```
Linear mixed model fit by REML ['lmerMod']
Formula: Body.Weight ~ Breed + (1 | Animal)
   Data: df_bw_br_rep

REML criterion at convergence: 61.8

Scaled residuals:
    Min      1Q  Median      3Q     Max
-1.3714 -0.5383  0.0640  0.3213  1.4305

Random effects:
 Groups   Name        Variance Std.Dev.
 Animal   (Intercept) 426.21   20.645
 Residual              22.98    4.794
Number of obs: 12, groups:  Animal, 4
```

Repeated Observations in Both Predictors and Response



Statistical Analysis

- Use Machine Learning Approaches
- First approximation:
  - Compute mean/median of BC
  - Fit repeated observation mixed model as in type 2